# NAVAL AIR DEVELOPMENT CENTER

WARMINSTER, PA. 18974

REPORT NO. NADC-72049-VT 29 MARCH 1972

## TEST PLAN FOR A STRUCTURAL INTEGRITY INVESTIGATION FOR THE CH-46 AFT TRANSMISSION PLANETARY CARRIER BEARING NUT IN SUPPORT OF THE ANALYTICAL REWORK PROGRAM

FINAL REPORT

NAVAIR WR-25145/24, Work Unit GA8-2

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DEPARTMENT OF THE NAVY
NAVAL AIR DEVELOPMENT CENTER
JOHNSVILLE
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Air Vehicle Technology Department

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Reported by R. P. SWARTZ

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## INTRODUCTION

During the investigation of a CH-46D helicopter crash S/N153967 at New River in 1967, it was determined that the cause of the crash was the disengagement of the planetary gear carrier self-locking nut, P/N BACN 10GR39, which allowed the planetary gear carrier assembly to drop. This resulted in complete disengagement from the sun driving gear splines with consequent loss of power to the aft rotor shaft. It was also determined during this investigation that rotation of the bearing on the planetary carrier, due to a low locking torque, would produce a rotational force on the self-locking nut in the loosening direction, thereby contributing to its removal.

Reference (a) stated that the recommended fix of increased torque values of 1320-1570 lb-ft should provide adequate clamping force to adequately retain the bearing inner ring regardless of the amount (within blueprint tolerance) of interference fit. As a result, the increased torque values were used in all CH-46 helicopters.

In December 1971, rotor desynchronization in CH-46D, S/N 154804, during approach to Yokota Air Base in Japan caused a second crash. Again the cause was traced to a disengaged planetary gear carrier self-locking nut. The threads on the planetary gear carrier and the self-locking nut were in good condition with no burrs.

As a result of this mishap, a contractor designed fix of pinning the self-locking nut to the planetary gear carrier through the threads, figure (1), was incorporated in CH-46 helicopters. During the installation of this fix, it was noted that torque values on the self-locking nut varied from 300 to 1800 lb-ft.

During a meeting between NARF CHPT (Naval Air Rework Facility, Cherry Point) and NADC (Naval Air Development Center) personnel, it was discussed that another cause of nut loosening might be shock loads imposed during hard landings. It is considered possible that the loading condition could cause to be developed, axial loads of sufficient magnitude to pop the nut off the planetary carrier, or at least over a single thread, thereby relieving the torque. Subsequent axial shock loads might pop off the nut one thread at a time. At the time of the investigation of the 1967 accident NARF CHPT had performed a test and determined that the bearing retaining nut could be removed from the planetary carriers by an axial force without damaging the threads. However, records of this test have been destroyed. If this is the case, pinning as shown in figure 1, would not eliminate the problem since the forces would be along the pin.

NARF CHPT requested through reference (b) that an investigation into the force required to remove the nut, both in the unpinned and pinned version, be performed to determine the efficacy of pinning the self-locking nut.

## SPECIMEN DESCRIPTION

Two configurations of the planetary gear carrier assembly will be required for this investigation. The first test specimen will consist of the planetary gear carrier P/N A02D2419, bearing P/N A02DS270 and planetary gear carrier locking nut P/N BACN 10GR39. These parts are shown in figure 2 in their relative positions. The threads of the locking nut and the planetary gear carrier engage only 3-4 threads when assembled. The specimen will be received from NARF CHPT assembled and torqued to the high torque value.

The second test specimen will be identical to the first specimen except that the self locking nut will be pinned in two places 180 degrees apart as shown in figure 1.

## INVESTIGATIVE APPROACH

An unpinned specimen of the planetary carrier assembly will be mounted in a suitable rigid test fixture. Axial loads will be applied to the bearing to determine the force required to pop the nut off the planetary carrier, figure 3. This test will be performed on both the unpinned and pinned versions of the planetary carrier assembly to determine the difference in force required to remove the nut.

The second part of the test will be to apply a repeated shock load with the specimen mounted in the same test fixture. These loads will be of a lower magnitude than that obtained from the static test. Periodically during the cycling the torque value of the nut will be checked to determine if there has been a change. The nut will then be retorqued and the test continued.

Again, both pinned and unpinned versions of the planetary carrier assembly will be tested.

In the event of a bearing failure during the test it will be replaced with a dimensionally identical solid ring which will be considered as part of the test fixture.

REFERENCES

(a) NAVAIRSYSCOM letter AIR-536411/11:TA of 16 April 1969

(b) NAVAIREWORKFAC CHERPT MSG 2121412 March 1972

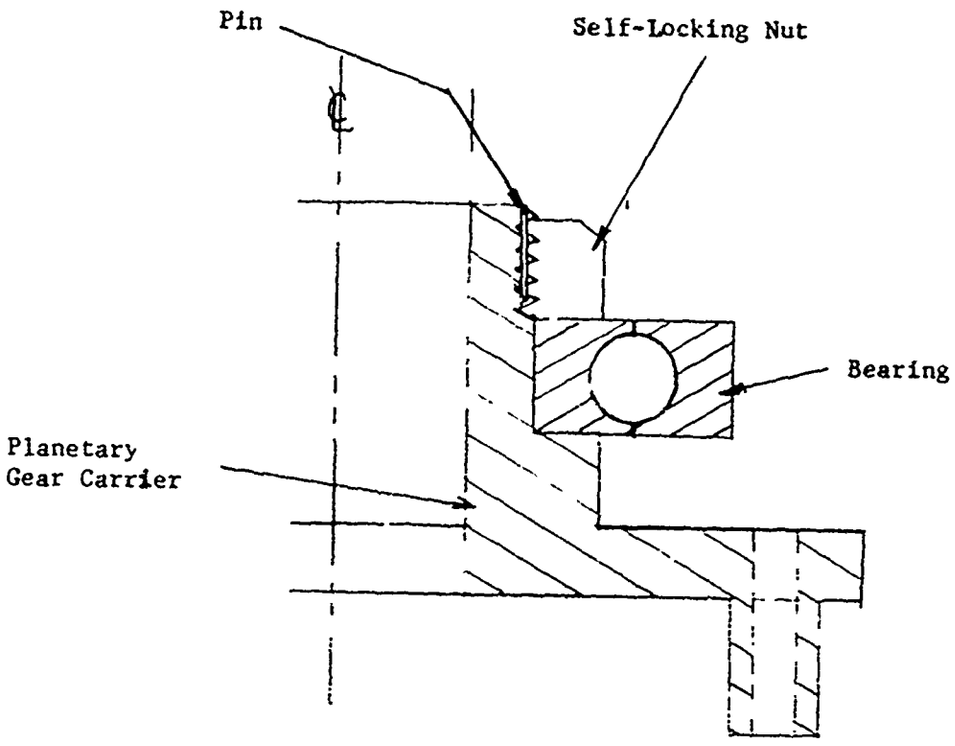


Figure 1. Pin Fix Modification

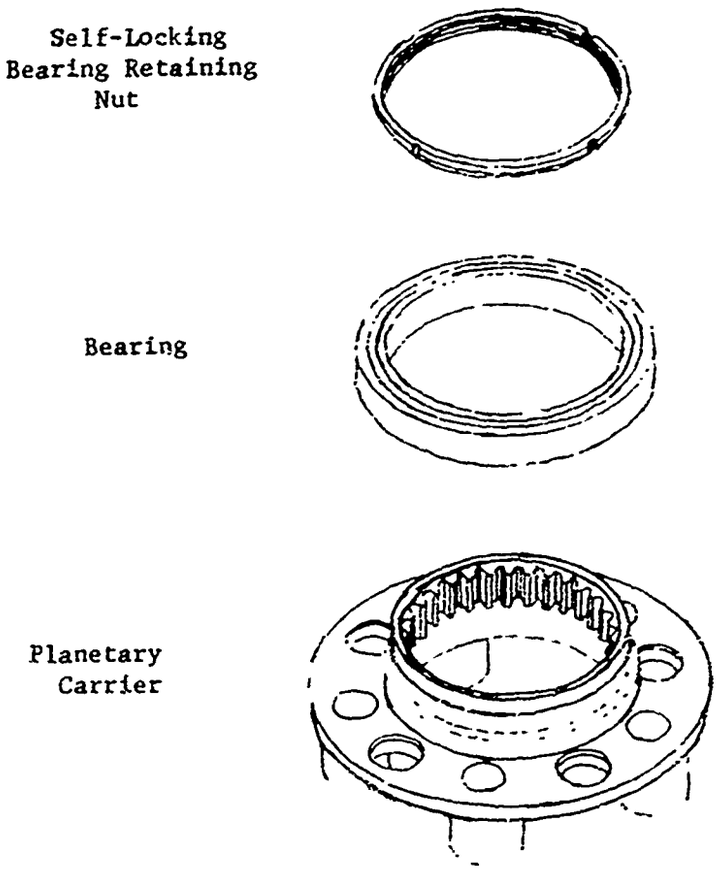


Figure 2. Test Specimen

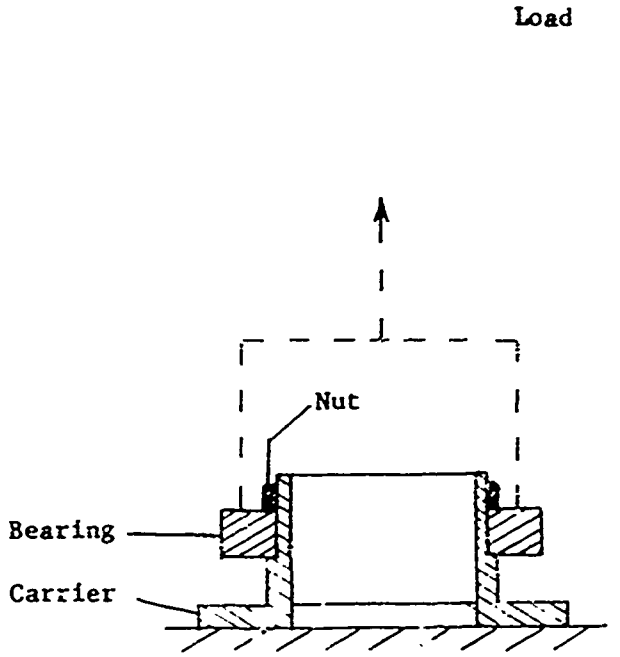


Figure 3. Test Setup